

Trace minerals in cattle: Maternal transfer, fluctuations and production cycle changes

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Abstract

Reproductive performance is 1 of the key economic drivers in both beef and dairy production. The roles of various trace minerals in cattle reproduction have been well documented. Identifying key risk periods of imbalance of these trace minerals, due to normal physiological events like maternal transfer or environmental exposure to antagonistic minerals, may enable practitioners to formulate supplemental strategies to minimize the risk and improve or maintain herd reproductive performance.

Key words: cattle, trace minerals, reproduction

Résumé

La performance de reproduction est l'un des moteurs économiques les plus importants dans la production laitière et de boeuf. Le rôle de certains oligo-éléments dans la reproduction des bovins est bien documenté. L'identification d'importantes périodes à risque pour un déséquilibre dans ces oligo-éléments, causé par des événements physiologiques normaux comme le transfert maternel ou par l'exposition environnementale à des minéraux antagonistes, pourrait permettre aux praticiens d'élaborer des stratégies de supplémentation qui minimisent le risque et améliorent ou maintiennent la performance de reproduction du troupeau.

Adequate trace mineral levels are thought necessary to optimize cow reproduction, bull reproduction, and also calf health and calf performance.^{2,12} Native forages grazed by beef cattle are generally marginal or deficient in Cu, Mn, Se, and Zn concentrations.¹⁵ The most widely used means of trace mineral supplementation for grazing cattle is the free choice, salt based, granular supplement;¹³ however, cattle do not balance their own mineral needs when consuming a free-choice mineral supplement.^{1,5} The most significant limitation to using free-choice mineral supplements is variation in individual animal intake.^{5,9} The mineral status of cattle also changes significantly over time and is not a constant, with the most significant changes occurring around the event of calving.⁸

Changing mineral status in cattle using different oral mineral compounds takes several weeks to months.⁷ The availability of injectable trace mineral formulations has provided us with more options, where plasma changes are measurable within hours and liver mineral value changes

within 1 day.²⁰ An additional difference between oral and injected trace minerals is the exposure and impact of antagonist minerals in the diet. The absorption, availability, and use of oral minerals are impacted by these antagonists, e.g. iron, molybdenum, sulfur, and calcium at different rates, reducing the animal's trace mineral status, and the injected trace minerals are not exposed to this effect.¹⁶

Most minerals serve 2 distinctly different purposes, as a structural component in certain tissues or as a co-factor in enzyme systems (both regulatory and as antioxidants).¹⁷

Breeding females have 2 risk areas with regards to trace mineral imbalances. The 30 to 90 days prior to breeding will impact the follicle, ovulation, formation of the corpus luteum, as well as early embryonic development.^{11,12,14} Another key period is pregnancy, especially the last 90 days of gestation as maternal transfer into the calf liver occurs during this time period.¹¹ This transfer and the event of calving will lead to significant drop in maternal mineral status.^{8,11}

Calves are born with higher trace mineral levels than the dam;¹¹ however, cow's milk is a very poor source of trace minerals³ and significant declines in mineral status compared to birth levels are evident at 60 to 90 days of age, declining further up to weaning.^{4,10} The risk areas for calves are their trace mineral status at birth, at first vaccination, and at or before weaning. Both disease and vaccination with modified-live vaccine will cause a further decline in mineral status of cattle.⁶

Trace mineral status impacts bull breeding soundness in several ways. In developing bulls, scrotal size, semen quality, and semen quantity are impacted.^{18,21} The key risk periods in developing bulls are prior to weaning, right up to final breeding soundness examination, prior to sale or at breeding time. In mature breeding bulls, trace minerals may be particularly critical for normal spermatogenesis, sperm morphology, and sperm motility, and as such there are significant risks prior to the last sperm-developing cycle before breeding soundness examination and breeding (on average 61 days prior to intended use).^{2,19}

Once all the risk areas are clearly understood, practitioners will know when and how to utilize oral and injectable technologies to adequately manage each risk.

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